

CORPS OF ENGINEERS IMPLEMENTATION

OF

NONSTRUCTURAL MEASURES

by

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## RESEARCH SUMMARY

The objective of this paper was to document the nonstructural projects (to reduce flood damage) implemented by the Corps of Engineers. Much of the findings in this paper was based on a questionnaire distributed to the planning elements of all 38 Corps Districts. The questionnaire surveyed the Districts for examples of nonstructural measures, related problems, and recommendations in improvement of current policy.

Of the traditional nonstructural measures such as relocation, floodproofing and flood warning, the Corps has only implemented two relocation projects. Construction on both projects, Prairie du Chien and Allenville, is in progress. However, the Corps has implemented other nonstructural measures of the type where undeveloped floodplain lands are acquired for overbank storage, recreation, or floodplain preservation. Good examples of these are the Charles River project and Indian Bend Wash; but these projects are unique, and the planner must be alert to develop these unique opportunities.

In general, about 10 other studies that feature either nonstructural or a mix of structural/nonstructural measures seem likely to be authorized for implementation.

The Corps Districts identified 10 problem areas that were impediments to Corps implementation of nonstructural measures. They were (1) lack of local support or acceptance, (2) economic feasibility, (3) lack of cost-sharing policy guidance, (4) degree of protection, (5) plan formulation, (6) lack of Division/OCE guidance and support, (7) institutional/social constraints, (8) lack of

nonstructural experience, (9) no OMB/Secretary of the Army support, and (10) lack of understanding of techniques for nonstructural evaluations.

The Corps Districts made recommendations to improve current policy on non-structural measures. They involved areas such as benefit evaluation, cost-sharing, recognition of limitation of nonstructural measures, level of protection, continuing authority after disasters, floodwarning and preparedness planning and freeboard for floodproofing.

## INTRODUCTION

The intent of this research paper is to document the level of Corps implementation of nonstructural measures to reduce flood damage. It is intended that Corps planners at the District level and reviewers at the Division/OCE/BERH levels benefit from this paper. Much of the findings in this paper was based on a questionnaire prepared and distributed to all Corps Districts. The questionnaire surveyed the District's planning elements for examples of implementation of nonstructural measures, related problems, and recommendations for improvement in current policy. Based on their responses, about one-half of the Corps Districts were subsequently contacted by telephone to discuss on-going studies that feature nonstructural measures.

It is the writer's opinion that the discussion in this paper represents the most accurate description to date of the problems of nonstructural measures from the viewpoint of Corps planners as well as an accurate documentation of the number of Corps nonstructural projects. This is because most of it is based on a survey of what District planners at the project management level perceive to be impediments to the planning and implementation of nonstructural measures.

The first two chapters, Historical Perspective and Nonstructural Regulations, have been written to describe the regulatory arena of constraints and policy guidance that nonstructural measures must be developed under. Chapter 3, Corps Implementation and Case Studies, is the heart of the paper and was originally selected to be the topic because there wasn't an effort in the

Corps to keep an official record of nonstructural projects.<sup>1</sup> And since I was in a position to survey all the Corps field offices, I couldn't pass up the opportunity to inquire about impediments to the nonstructural planning process and recommendations for improvement. These topics are covered in Chapters 4 and 5. And finally, the last chapter discusses the outlook for nonstructural measures in the near future as far as the Corps is concerned.

## CHAPTER 1: HISTORICAL PERSPECTIVE

Historically, the Corps of Engineers has been involved in structural measures such as dams, levees, and channels to control flooding. Many people believe that these structural flood control facilities have often encouraged unwise development in the flood plain that have led to greater losses due to floods. Moreover, these measures have increasingly come under attack from environmental and special interest groups. As a result, recent directives from the President and the Congress of the United States have mandated that flood control studies now include increased emphasis on nonstructural measures to reduce flood damage. The term nonstructural refers to all measures other than the structural solution, such as dams or channels that have traditionally typified Government efforts to solve flood problems. Better termed as nonstructural flood damage reduction measures, these measures usually consist of floodproofing of buildings, flood insurance, flood warning systems, relocation from flood-prone areas and flood plain regulation.

For most Corps water resources planners the nonstructural era began sometime in the mid to late 1970's. If he started planning nonstructural measures in the mid-1970's (or even earlier) he encountered many problems in developing implementable or meaningful nonstructural measures. Since he had little or no experience with nonstructural measures, the Corps planner was faced with problems he had not encountered before such as local unacceptability, degree of protection, plan formulation, cost-sharing requirements, etc.<sup>2</sup> He could not obtain much assistance from the reviewers at the Division and OCE levels because they didn't have much experience in reviewing nonstructural measures.

In more recent years, the Corps has come under increasing attack from environmental and other special interest groups for not implementing many nonstructural projects. They have assumed that the Corps' inability to develop implementable nonstructural measures is a result of their unwillingness to depart from the more desired structural measures. They have implied that the Corps has deliberately ignored the directives of the President and Congress. This is not true.

The Corps' lack of nonstructural projects looked especially bad when viewed in light of the statement made by Lieutenant General John Morris, Chief of Engineers, "We now look at nonstructural options as the most desirable solution to flood problems since they are usually least disruptive to the natural environment." This statement was made before the House and Senate Subcommittees on Public Works of the Committees on Appropriations, 9 February and 8 March 1977.

But, in only the last year or two, Corps planners have come to realize that, because of the inherent problems in the evaluation and development of nonstructural projects, nonstructural measures are not the panacea to solving flood problems that has been previously advocated by environmentalists. For example, in an interview in the Fall 1980 issue of Water Spectrum, Lieutenant General Morris said, "Nonstructural measures alone cannot solve all our problems. However, nonstructural solutions are considered in every situation we encounter-- flood control as well as other water resources projects. We seldom develop a plan that is totally nonstructural or totally structural. We integrate both methods on a case by case basis."<sup>3</sup>



The following chronology of legislative and executive actions briefly describes the Federal role in the development and implementation of nonstructural measures.

1938 Flood Control Act. Section 3 of this act authorizes the Chief of Engineers to contribute to the evacuation of the floodplains if it is less costly than a structural project, assuming both plans were economically justified.<sup>4</sup>

1960 River and Harbor Act (PL 86-645). The 1960 Flood Control Act authorized the Corps of Engineers to provide states and localities with information needed to regulate floodplain lands. This act authorized the Floodplain Management Program.

House Document 465. In 1966 the Presidential Task Force reported 16 recommendations in House Document 465, "A Unified National Program for Managing Flood Losses," that dealt with needs and problems with regard to existing Federal programs and their impact at the state and local levels.

Executive Order 11296. Issued in August 1966, this order directed Federal agencies to evaluate the flood hazard before funding construction projects or acquiring or disposing of Federal property.

National Flood Insurance Act of 1968 (PL 90-448). This act made available subsidized flood insurance for floodplain occupants and emphasized local floodplain regulations to reduce flood losses.

Flood Disaster Protection Act of 1973 (PL 93-234). This Act amended the National Flood Insurance Act of 1968 by placing strict requirements and incentives for communities to participate in the National Flood Insurance Program.

Water Resources Development Act of 1974 (PL 93-251). Section 73(a) of this Act required the consideration of nonstructural measures in flood control projects and Section 73(b) provided up to 20 percent non-Federal cost-sharing in recommended nonstructural measures. Three Corps flood control projects that involved nonstructural measures were also authorized in this Act: Prairie du Chien, Wisconsin; Charles River Basin, Massachusetts; and Littleton, Colorado.

Executive Order 11988. Issued on 23 May 1977, this order directed Federal agencies to seek alternatives to avoid locating or supporting activity in floodplains.

The President's Water Policy Message of 8 June 1978. This policy message encouraged greater utilization of nonstructural measures by its specific directives to: (1) require the formulation of at least one primarily nonstructural alternative plan where a structural project is being considered, (2) restructure Federal cost-sharing to remove biases against nonstructural measures, and (3) use Federal programs to acquire flood-prone land and property.<sup>5</sup>

Revisions to Principles and Standards for Planning Water and Related Land Resources, published in Federal Register December 14, 1979.

In response to a memorandum from President Carter to the Water Resources Council, the Principles and Standards were revised. One of the major revisions required the preparation and inclusion of a primarily nonstructural plan as one alternative whenever structural projects or program alternatives are considered. Furthermore, alternative plans should not be limited to those that the Federal Government could implement and the cooperative role of local, state, regional, and Federal organizations in implementing alternatives was stressed.

## CHAPTER 2: CORPS PLANNING REGULATIONS AND POLICY GUIDANCE ON NONSTRUCTURAL MEASURES

The following Engineer Regulations and policy guidance on the evaluation and development of nonstructural measures are included to set the framework for the remainder of the paper. Most readers are probably quite familiar with them.

ER 1120-2-117 (17 August 1970), Alternatives in Flood-Related Planning. This was actually the first articulation of the present Corps policy on nonstructural plan formulation. Although dated 17 August 1970, it surprisingly establishes policy that is still very relevant. It required the consideration of all relevant means and alternative approaches that contribute to the appropriate use of floodplains such as floodplain management. The objectives of NED, EQ, Well-Being of People, and Regional Development were stated as well as adherence to EO 11296 (forerunner of EO 11988). Measures to modify flood damage susceptibility included floodproofing, zoning, permanent evacuation, flood insurance, and flood warning. This ER is not well known as nonstructural policy guidance and has not been fully utilized probably because the word "nonstructural" doesn't appear and because nonstructural type concepts were not taken seriously in 1970.

ER 1105-2-351 (13 June 1975), Evaluation of Beneficial Contributions to National Economic Development for Floodplain Management Plans. This regulation covers the principles, standards, procedures and measurement techniques for evaluating National Economic Development benefits for floodplain management plans.

ER 1105-2-353 (4 April 1979),<sup>6</sup> Evaluation of Nonstructural Measures. This regulation provides instructions for the evaluation of National Economic Development (NED) benefits and costs for evacuation and relocation as non-structural measures for floodplain management.

Policy Guidance, Nonstructural Alternatives, DAEN-CWR-P, 15 October 1979.

This Policy Guidance was written in the format of 16 questions and answers on issues pertaining to nonstructural measures. Its purpose was to clarify policy established in ER 1105-2-353 and ER 1165-2-122 and issues raised in a report by the St. Paul District, "The Development of Nonstructural Alternatives," May 1979.

ER 1165-2-122 (proposed rule),<sup>7</sup> Use of Nonstructural Measures in Planning for Flood Damage Reduction. This regulation provides policies to guide the formulation of flood damage reduction plans which incorporate nonstructural measures, or which consist entirely of nonstructural measures.

Policy on Nonstructural Flood Damage Reduction Measures, DAEN-CWR-P, 6 January 1981. This Policy Guidance, issued by the Assistant Secretary of the Army for Civil Works, serves as interim guidance prior to the publication (and revision) of ER 1165-2-122 in the Federal Register as formal guidance. Some of the key points of this Policy Guidance were: (1) as a prerequisite for Federal implementation of a flood damage reduction project, the local sponsor is required to adopt floodplain management programs in and adjacent to the project area, (2) more emphasis on recreational or environmental use of evacuated floodplains, (3) the formulation of plans to provide a level of protection that would insure wise use of the floodplain rather than some

predetermined level, (4) the local share of costs for recommended nonstructural measures will be 20 percent of the first cost, and (5) when flood warning and/or temporary evacuation are elements of the adopted plan, the Federal sponsor can participate in the cost of equipment exclusively devoted to flood warning systems and/or temporary evacuation.

### CHAPTER 3: CORPS OF ENGINEERS IMPLEMENTATION AND CASE STUDIES

This chapter is the focal point of the research paper. My original intent in writing this paper was to determine the extent of Corps implementation of non-structural measures. I wanted to know exactly how many nonstructural projects the Corps had implemented, especially since the Congressional and Presidential mandates of the 1970's. As mentioned before, I had based much of this paper on a questionnaire sent to the 38 Corps Districts (33 responses received).

The St. Paul District's report on nonstructural alternatives,<sup>8</sup> published in May 1979, contained an excellent discussion and summary of the Corps implementation of nonstructural measures. But many things have happened since then. (Or, I should say many things have not happened.) For example, the preface to the St. Paul report said that ". . . one (nonstructural) project will begin implementation this year in Wisconsin (Prairie du Chien) with a second possible in Texas (Baytown) beginning in 1980. Three others, two in Michigan (Midland) and one in Georgia (Peachtree and Nancy Creeks), have more remote chances for eventual implementation. No other such projects are on the horizon nor do they seem likely."<sup>9</sup>

Since then the following have occurred: Prairie du Chien--relocation from the 10-year floodplain in progress; Baytown--relocation rejected by local community; Midland--Phase I GDM presently under review at Board of Engineers for Rivers and Harbors; and Peachtree and Nancy Creeks--floodproofing plan rejected by local sponsor. Furthermore, the town of Allenville, Arizona was relocated under the Section 205 Continuing Authority for Small Flood Control

Projects. Several other nonstructural projects developed under the Small Projects Authority have a good chance for implementation in the near future. All of the aforementioned projects will be discussed in greater detail later on in the chapter.

### Corps Implementation

The definition of nonstructural measures and its distinction from structural measures can be a source of controversy in itself. Let's just say that rather than directly controlling floods like a structural project would, they affect human behavior in a manner that will reduce flood damages. For practical purposes, I have lumped nonstructural measures into two convenient categories: (1) The more traditional nonstructural measures that the Corps can implement such as relocation, floodproofing, and flood warning, and (2) the types of nonstructural measure where sparsely developed or undeveloped floodplain lands are acquired for overbank storage, recreation, or to preserve the natural floodplain by prohibiting future development. There seems to be over a score of projects that involve this type of measure. The most notable projects in this category include the Charles River Basin Natural Storage Project, Indian Bend Wash, and Littleton, Colorado. The Charles River project in Massachusetts involved acquiring wetlands and adjacent areas in the upper Charles River to naturally preserve its flood storage capability in order to preclude the future need for a structural project. The Indian Bend Wash project in Scottsdale, Arizona included a greenbelt floodway that functioned as a recreational facility involving a park and golf course. The project at Littleton, Colorado involved acquiring 750 acres of vacant



floodplain land below Chatfield Dam for use as a greenbelt floodway in place of a channelization plan. The projects in this second category have several things in common: they all deal with sparsely developed or undeveloped floodplain,<sup>10</sup> they represent areas unique to your typical floodplain, and the planner must be alert to these unique opportunities. It is evident that the Corps has been alert to these opportunities by its implementation of these projects and they will continue to do so as the opportunity arises.

### Category I

The nonstructural measures in the first category (relocation, floodproofing, and flood warning) normally deal with more developed floodplains. This is the situation that the Corps planner normally finds himself faced with when he attempts to solve the flooding problems of a community that has suffered flood damages. Because these communities are fairly well-developed, social and institutional problems will be prevalent, making implementation more difficult. The following is a description of the more traditional nonstructural projects (such as relocation, floodproofing, and flood warning) that the Corps has been authorized to implement.

Klamath, California. In 1964, the Corps was involved in a relocation of the community of Klamath after a flood had destroyed the town. This project has not been mentioned often as an implemented nonstructural measure because many do not know about it, and more specifically, it was not planned and authorized under the more relevant regulatory and institutional framework of the 1970's.

Prairie du Chien, Wisconsin. This is the most well known nonstructural project that the Corps has been authorized to implement. Proponents of nonstructural measures and most Corps planners are very familiar with this project.

Basically, the plan called for relocation of 130 residences and two businesses from St. Feriolo Island at Prairie du Chien and the 10-year floodplain on the mainland adjacent to the island.<sup>11</sup> At the time of this writing, just over half of the structures have been relocated with a projected completion date of late 1982.<sup>12</sup> This project has raised many significant policy questions and also helped shape some of the current policy.

Allenville, Arizona. In March 1978, intense flooding from the Gila River forced residents of the town of Allenville, a small community 35 miles west of Phoenix, to abandon their homes. Since then, two additional major floods have occurred, rendering most of Allenville uninhabitable. Since then, the residents of Allenville have been living in temporary mobile homes provided by HUD funds. A study of Flood Damage Reduction was carried out by the Los Angeles District under the authority of Section 205 of the Flood Control Act of 1948, the continuing authority for small projects. The study was initiated in mid-1979 and the Detailed Project Report was approved by OCE in July 1980. The project recommended the construction of a replacement community for 35 families who elected to be relocated. Construction began in January 1981, with the cost-sharing being 80 percent Federal and 20 percent shared by the State of Arizona.

Allenville was the first use of the Small Flood Control Project Authority for a nonstructural project. As such, it should open the gates for the use of the

Section 205 Small Flood Control Project Authority as a means of implementing nonstructural projects. Because Section 205 studies do not have the extensive review and authorization process that a feasibility study has, they can be completed and implemented in a short amount of time, and thus be more responsive to the needs of the community.

### Case Studies

This section describes current Corps studies in progress that contain nonstructural measures and which, at the time of this writing (January 1981) are likely to be implemented in the near future.

Midland, Michigan. The Phase I GDM, "Saginaw River, Michigan and Tributaries, Flood Control on Tittabawassee River at Midland," is currently at the Board of Engineers for Rivers and Harbors (BERH) for action. The recommended Federal project consists of an evacuation plan that involves the fee acquisition and demolition of a total of 101 residences and three commercial structures. The evacuated area will be converted to recreational use. The total project cost is \$5,657,000 with a benefit-cost ratio of 1.16.<sup>13</sup> This project enjoys good local and political support.

Bassett Creek, Minnesota. This project is currently in Phase II of Advanced Engineering and Design. The selected plan was a combination structural-nonstructural plan that would reduce flood damages in the Bassett Creek watershed, Hennepin County, Minnesota.<sup>14</sup> The structural measure consists of a series of small control structures to temporarily impound flood waters. The nonstructural plan includes the floodproofing of 18 residences. The project first cost is \$10,140,000 with a B/C ratio of 1.5.

Lock Haven, Pennsylvania. The Phase I GDM was recently approved by BERH. The selected plan consisted of levees, floodwalls, evacuation of 139 structures and floodproofing of four others. The levees and floodwalls will protect the city of Lock Haven from flooding on one side of the river (West Branch of the Susquehanna River) while 139 structures will be relocated and four others floodproofed on the other side of the river in the town of Lockport--partly because the levees have increased flood heights on the other side of the river in Lockport. The total first cost is \$59 million with a BCR of 1.5.

Village Creek, Alabama. This project, located in Birmingham, Alabama, is currently in stage III of a feasibility study. The selected plan for flood damage reduction was the evacuation of 993 structures and a 2.2-mile channel enlargement segment.<sup>15</sup>

Green Brook Sub-basin, New Jersey. The feasibility report of this study is currently at BERH for action. The selected plan consists of structural improvements with some nonstructural features. The structural plan consists of levees and floodwalls along the river while the nonstructural plan includes evacuating nine structures and floodproofing 33 structures.

Whitewater River, California. Section 404 of the Water Resources Development Act of 1980, a bill introduced before the U. S. Senate on 30 September 1980, authorizes the Corps to develop and implement a flood warning system for the Whitewater River Basin, San Bernardino and Riverside Counties, California at a cost of \$300,000.<sup>16</sup> If this bill is enacted into law by Congress and the President, the Corps can proceed to design, purchase, and install a flood warning system (complete with gages and a microcomputer)! It remains to be seen whether this system can be implemented directly or whether a feasibility study

and EIS are required. Because of its precedent-setting nature, it bears watching.

(Note: The remaining case studies were all developed under the Section 205 Continuing Authority for Small Flood Control Projects.)

Brewton and East Brewton, Alabama. A draft Detailed Project Report has been completed and will be submitted for OCE approval. The selected plan consists of the evacuation of about 17 structures (with floodproofing and flood warning the responsibility of the local sponsor).<sup>17</sup> This plan would reduce flood damages from Murder Creek at East Brewton, Alabama. The total first cost is \$1,320,000 with a B/C ratio of 1.2.

Burton, Michigan. This project is in the early stages of a Section 205 study. The nonstructural plan consists of the relocation of about 20 to 30 homes.<sup>18</sup>

Haikey Creek, Oklahoma. The selected plan is a combination structural/non-structural plan located in the vicinity of Broken Arrow, Oklahoma. A Detailed Project Report is currently being reviewed by OCE. The structural plan consists of a levee that will protect 40 homes while 10 other homes will be relocated and floodplain regulation implemented. The Federal cost is \$1,370,000 while the local share is \$730,000.<sup>19</sup>

Waimea, Hawaii. The selected plan is a combination levee plan and flood warning system for the Town of Waimea, Island of Kauai, Hawaii. The flood warning system will be implemented by the Corps and is the first test of the OCE Policy Guidance of 15 October 1979, which stated, "The federal government may participate in the first cost of equipment solely for a flood warning system when the

costs are separable and the warning system is an integral part of the recommended plan." (Similar policy guidance was mentioned in the 6 January 1981 policy statement from DAEN-CWR-P.) The total project first cost is \$2,572,000 with a B/C ratio of 1.3.<sup>20</sup> (The Pacific Ocean Division has implemented several flood control projects that have included a mix of nonstructural type measures such as flood storage and zoning.)

Warwick, Rhode Island. This project was broken off from a much larger study of the flooding and water resources problems of the Pawtuxet River Basin. A draft DPR is currently being prepared and the recommended plan involves the relocation of about 54 families at a total cost of \$2.5 million.<sup>21</sup>

In summary, only two Corps projects that feature relocation as the selected plan (Prairie du Chien and Allenville) have been authorized since the Water Resources Development Act of 1974 and other legislative and Presidential directives of the 1970's. In fact, of all the Federal agencies which adhere to the Principles and Standards for Water Resources Planning, such as the Corps, Water and Power Resources Services, Soil Conservation Service, TVA, and Fish and Wildlife Service, the Corps is the only one to have a totally nonstructural plan authorized for construction since the Principles and Standards were promulgated. However, the outlook is not completely bleak for nonstructural measures because they are alive and well in the Section 205 Small Flood Control Project Authority. But since the Federal funding under this authority is limited to only \$2 or \$3 million, larger communities might not benefit. On the other hand, the opportunities will continue to occur for implementing nonstructural projects that involve land acquisition and modification of floodplain use such as Indian Bend Wash or the Charles River Project. Corps planners will continue to be alert to opportunities to implement these types of nonstructural projects.

It would be correct to conclude that a flood damage reduction plan that featured exclusively nonstructural measures such as relocation and floodproofing would be extremely difficult to implement in highly developed floodplain lands.

## CHAPTER 4: IMPEDIMENTS TO CORPS IMPLEMENTATION OF NONSTRUCTURAL MEASURES

This chapter describes the impediments to Corps implementation of nonstructural measures based on a survey of all Corps districts. Each Corps field office was asked the question, "What do you see as impediments to Corps implementation of nonstructural measures?" Not surprisingly, the two biggest obstacles to Corps implementation were (1) lack of local support or acceptance, and (2) economic feasibility. Table 1 shows what the District responses were.



TABLE 1  
IMPEDIMENTS OR PROBLEM AREAS

	(# of respondents out of 33)
1. Lack of local support or acceptance	18
2. Economic feasibility or analysis	16
3. Lack of cost-sharing policy guidance	7
4. Degree of protection	6
5. Plan formulation	5
6. Lack of Division/OCE guidance and support	3
7. Institutional/social constraints	3
8. Lack of nonstructural experience	3
9. No OMB/Secretary of the Army support	3
10. Lack of understanding of techniques for nonstructural evaluation	2

1. Lack of Local Support or Acceptance. It is not surprising that this is the biggest impediment to implementation of nonstructural measures. This is because nonstructural measures, by their nature, alter human behavior and reaction to floods rather than directly controlling the floods. It is well known that human behavior is more complex and difficult to control than a natural element like floodwaters. Interestingly enough, none of the respondents made any recommendations on how to overcome this lack of local acceptance. Evidently, they feel nothing can be done. This is in contrast to the nine other above-mentioned problem areas where many recommendations were made.

Many project managers feel that residents of a local community perceive non-structural measures such as relocation or floodproofing to have a lower degree of protection and be less effective than a structural project. A structural project will protect them from floods and allow them to continue living their chosen life style in the location they have selected. There can also be resentment by residents higher up in the floodplain who are not eligible to be relocated or by nonfloodplain residents towards giving money to relocate (or floodproof) other residents. "Why should I use my tax money to relocate someone who was dumb enough to move into the floodplain?" is often heard. Unfortunately, that was how the relocation of Baytown was rejected. In an effort to generate the local share of the funding to relocate Baytown, a bond issue was floated and rejected.<sup>22</sup> (A subsequent bond issue was again voted down.) Evidently, the residents to be relocated were actually in favor of moving, but other residents in the area didn't want to pay for it. Similar problems occurred when the town of Allenville, Arizona was proposed for relocation. Nearby residents were very unreceptive to using Federal money for relocation. Residents of the area where the community of Allenville was

supposed to move to were very unhappy to have an influx of (poor) people moving into their area.

Other pertinent problems mentioned in the survey were the social disruption to relocated communities, the unequal treatment of homeowners in the floodplain, and local government opposition. It was mentioned often that local governments oppose relocation because they did not want to stifle development and lose tax dollars.

2. Economic Feasibility. It is well known that few nonstructural measures are economically justified, so it is not surprising that so many respondents felt that this is a major impediment to implementation. In fact, only 17 District offices indicated that they had ever had a B/C ratio  $\geq 1$  for a nonstructural measure at the Stage III level of a feasibility study. Studies at HEC and other Districts have shown that normally nonstructural measures are only economically feasible at a 10 to 15 year level of protection, if at all. Some project managers felt that nonstructural measures were at a disadvantage by using the same regulations and methods of analysis that are used for structural measures. It was also felt that nonstructural measures were economically unfeasible because the beneficial environmental or social features of nonstructural measures are intangible and are not quantified in the economic analysis. In that regard there was mixed feeling among the Districts on whether the new net benefits rule ( $NED + EQ = \text{Total benefits}$ , and plans need not be economically justified) will mean more implementable nonstructural measures. Only half the Districts felt that the new net benefits rule would justify more nonstructural projects. This may be because of the controversy over what constitutes an EQ plan. Even if a nonstructural plan was recommended on the basis of EQ, it still needs to overcome the problem of local support or acceptance.

3. Lack of Cost-Sharing Policy Guidance. This was felt to be a major issue inhibiting the development of nonstructural measures. Although Section 73(b) of Public Law 93-251 provides for up to 20 percent non-Federal cost sharing in recommending nonstructural plans, there was no firm OCE policy on this; rather, nonstructural plans were analyzed on a case-by-case basis to determine cost-sharing.<sup>23</sup> Hopefully, this issue will be resolved by the 6 January 1981 Policy Guidance on nonstructural measures issued by the Assistant Secretary of the Army for Civil Works and the subsequent publication of ER 1165-2-122.

4. Degree of Protection. Nonstructural is felt by many to be only a limited solution to flooding problems because it can only be justified for lower levels of protection. This can especially be a problem in floodproofing. For example, do we only floodproof a home 2 feet to protect against the 10-year flood while damages continue to occur from greater floods. And can we be liable for this damage?

Some respondents mentioned that ER 1105-2-111, which provided for a high degree of protection in urban areas, was contradictory to ER 1165-2-122, which prescribed that it was not appropriate to have a high common level of protection.\* One District said, "Nonstructural measures are not effective in alleviating such problems as disruption of business and activities, road and bridge damage (also social disruption and post-flood clean-up) . . . Local interests are interested in projects that can generally help upgrade an area from all standpoints--not just prevention of economic loss to existing situations."

\*It should be noted, though, that the two ER's have different objectives.

5. Plan Formulation. Many of the problems encountered in plan formulation are covered in the other nine categories of problems. Some of the issues in formulating nonstructural plans were cost sharing, cost-sharing for EQ, definition of nonstructural measures (for cost-sharing purposes), individual versus group analysis of buildings (individual building analysis can be too expensive and impractical), and legal liability on private property. Floodproofing is especially hard to justify because of physical infeasibility, lower degrees of protection, noncompliance with EO 11988, local statutes prohibiting improvement of private property by Federal funds, legal liability for damaged homes, and renegotiation with different property owners during long planning and authorization stages. Current Corps policy discourages recommendation of floodproofing for a structure if it would cause the isolation and entrapment of occupants and thereby intensify the need for emergency action. Strict adherence to this policy would never result in floodproofing of residential structures, and many districts have eliminated a floodproofing plan because of this reason.

6. Lack of Division/OCE Guidance or Support. It was mentioned that Division/OCE had a lack of guidance on nonstructural issues (especially cost-sharing), no firm policy on nonstructural, and was biased towards structural projects. It might not be fair to blame Division/OCE for lack of guidance in this case. There was no firm policy on nonstructural measures because there was no experience (or precedent) within the Corps in planning, authorizing, and implementing them.

7. Institutional/Social Constraints. This category is related to the problem on local support and acceptance discussed before. Because of the length of time involved in the planning and authorization process, the institutional and social elements such as local officials and homeowners could be completely different or have different desires later on in the planning and implementation stages.

8. Lack of Nonstructural Experience. The relative lack of familiarity with nonstructural plans has adverse impacts on the quality of plan formulation and design, especially when compared to that for structural alternatives.

9. No OMB/Secretary of the Army Support. It is a common belief that the Office of Management and Budget was very unreceptive to nonstructural measures in the 1970's, especially when they first appeared.<sup>24</sup> Many planners also linked the Secretary of the Army's office to this unreceptiveness. Now, with the new net benefits rules (NED + EQ), it will be interesting to see how OMB or Congress reacts to nonstructural measures with EQ features, especially the cost-sharing arrangement.

10. Lack of Understanding of Techniques for Nonstructural Evaluation. This is similar to problem 8 and may have been caused by the lack of experience.

This chapter summarizes what the Corps Districts felt were the major impediments to Corps implementation of nonstructural measures. These problems correspond well with those found in other studies. For example, the St. Paul District's report on The Development of Nonstructural Alternatives described local acceptance, economic feasibility, plan formulation, lack of experience,

degree of protection, and lack of policy guidance as major problems; and in a report to the U. S. Water Resources Council by Dr. Gilbert White entitled Nonstructural Floodplain Management Study: Overview, it was indicated that impediments to implementing nonstructural measures were OMB resistance, economic justification, and lack of experience.

This chapter was written to look at the problems of developing and implementing nonstructural measures from a Corps planner's point of view, so that a better understanding of the nonstructural planning process can be developed.

## CHAPTER 5: RECOMMENDATIONS

This chapter summarizes the Districts' responses to the question, "What changes, if any, are needed in Corps of Federal water resources policy on nonstructural measures?" Since the responses were both diverse and meaningful, it was decided to list almost all of them. A few of the recommendations by the respondents showed unfamiliarity with existing policy and regulations.<sup>25</sup> Nevertheless, there is some validity to most of them. However, some of the answers were not recommendations but further discussions of problems.

1. Benefit Evaluation. The most popular response from the Districts pertained to the evaluation of benefits in the economic analysis. These responses all involved recommendations to either clarify the benefit evaluation procedures or the inclusion of additional benefits and elimination of some of the costs. In summary, the specific comments from the different Districts were: ". . . inclusion of more intangible benefits," ". . . greater use of social benefits," ". . . inclusion of damage reduction benefits," ". . . delete cost of land acquisition from benefit analysis," ". . . more clarification on use of recreational benefits," ". . . better methods for determining benefits," ". . . simplify and standardize the benefit evaluation procedures."

2. Cost-Sharing. The recommendations on cost-sharing consisted of some changes in policy and the desire for better guidance on cost-sharing. Specifically, the comments were: ". . . make nonstructural cost sharing more attractive," ". . . better cost-sharing guidance," ". . . clear guidelines and



change in current cost-sharing policy," ". . . give locals the chance to pay their costs over an extended period," ". . . change policy on types of recreation facilities to be cost shared in urban parks," ". . . full federal funding of first cost of flood warning system."

3. Recognition of Limitation of Nonstructural Measures. These recommendations involve promoting awareness of the fact that nonstructural measures are usually not feasible (probably in response to continual criticism project managers experience from environmental groups on the lack of nonstructural projects). The specific comments were: ". . . recognition that nonstructural measures cannot be economically implemented at less than a 25-year level of protection," ". . . stop touting nonstructural as the ideal answer to flood problems," ". . . recognize that few projects are economically justified," ". . . policy should recognize that nonstructural is often incompatible with local needs."

4. Level of Protection. The responses involving level of protection recommended better policy and guidance. They were: ". . . clarify level of protection ambiguity between ER 1105-2-111 and ER 1165-2-122," ". . . clear guidance on level of protection," ". . . specific policy on level of protection for floodproofing."<sup>26</sup>

5. Continuing Authority after Disasters. One District recommended Corps authority and funding to evacuate up to the 15-year floodplain during post-flood cleanup while another advocated a continuing authority to cooperate with local governments in purchasing buildings in the floodway when they are put up for sale.

6. Flood Warning and Preparedness Planning. There were a couple of recommendations for the Corps to develop and implement flood warning and preparedness plans (with the agreement of the National Oceanic and Atmospheric Administration).

7. Freeboard for Floodproofing. There were a couple of comments on freeboard for floodproofing.

8. Miscellaneous Recommendations. The following are responses that do not fit neatly into the categories mentioned above. Most of them deal with changes in current policy. ". . . local co-op agreements need to be more flexible," ". . . establish technical assistance program for nonstructural similar to the Flood Plain Management Services Program," ". . . Corps should take over National Flood Insurance Program," ". . . more firm policy on relocation," ". . . develop procedures for evaluating flood warning and floodproofing plans," ". . . develop methodology for quantifying EQ advantages of nonstructural plans," ". . . eliminate mandatory participation by all residents in project area," ". . . allow a longer time frame for affected citizens to decide on participation in nonstructural measures.

This chapter described the changes the Corps Districts felt were needed in Corps or Federal water resources policy on nonstructural measures. It is interesting to note that these recommendations were similar to those made by the St. Paul District in their 1979 report. The recommendations in that report were: (1) Broaden the principle of excluding certain financial costs associated with unquantifiable benefits from the benefit-cost ratio, (2) Seek continuing legislative authority for employing nonstructural measures immediately after flood emergencies, (3) Simplify plan formulation criteria by

planning for total acquisition of the design floodplain followed by individual disposition of each acquired property on the basis of technical and economic considerations, (4) Seek legislative authority to plan for, encourage, or bring about the optimum compatible use of project floodplains, and (5) Educate those within and outside the Corps as to the characteristics of nonstructural alternatives and their limitations compared to structural alternatives.<sup>27</sup>

From my experience in planning nonstructural measures for the Los Angeles District, I have advocated recommendations to change Corps policy on nonstructural measures such as: (1) Nonstructural measures should not be eliminated solely because of economics ( $B/C < 1$ ); (2) Flood warning and temporary evacuation should be implementable by the Corps (the 6 January 1981 policy guidance now allows this); (3) Increased use of the Section 205 Small Projects Authority to implement nonstructural measures; (4) The establishment of a continuing authority to implement nonstructural measures after disasters;<sup>28</sup> (5) The education of Corps and non-Corps elements as to benefits limitations of nonstructural measures, and (6) The use of a technical services program to develop nonstructural plans, such as the study HEC did for the Los Angeles District in developing improved flood preparedness plans for use by local agencies in the central Arizona area.

All of the recommendations made in this paper have some basis to them. To reject them on the premise that "we've always done it this way" is not good enough.

## CHAPTER 6: OUTLOOK FOR THE FUTURE

The outlook for the Corps implementation of nonstructural measures is not extremely bright. But neither is it bright for the large structural flood control projects because most of the feasible ones have been built already. Because of problems such as local acceptance and economic (or NED + EQ) justification, few nonstructural measures will be implemented. Although a nonstructural plan can now be recommended on the basis of environmental quality rather than economic feasibility, it will still require local acceptance and the existence of a bona fide opportunity for EQ. Furthermore, if a nonstructural project is recommended in a feasibility study on the basis of EQ, it is questionable whether it will be authorized and funded by the Congress and OMB of the near future.

There will be an increase in nonstructural projects being recommended and implemented under the Section 205 Small Project Authority. This will come about in part as the result of frustration over the long planning process involved in a feasibility report and its ability to survive the review and authorization process, as well as the more responsive time frame of 205 projects.

However, if most of the recommendations made in the previous chapter are adopted, there might be a silver lining in the clouds ahead for implementation of nonstructural measures.

QUESTIONNAIRE ON CORPS INVOLVEMENT IN NONSTRUCTURAL\*  
MEASURES TO REDUCE FLOOD DAMAGE

	<u>Yes</u>	<u>No</u>
1. Have any nonstructural measures exhibited a B/C ratio $\geq 1$ at the Stage III level of a feasibility study?	<u>18</u>	<u>15</u>
a. If so, what were the measures?		
b. Were any of these measures the recommended plan?		
2. After study, has a nonstructural measure ever been the recommended plan for Corps implementation under any of the existing Corps authorities?	<u>10</u>	<u>23</u>
a. What was the measure(s)?		
b. Under what authority?		
3. Has the District ever had a nonstructural measure authorized by Congress?	<u>5</u>	<u>28</u>
4. Does the District currently have a nonstructural measure included in a bill awaiting authorization?	<u>3</u>	<u>30</u>
a. What is the measure?		
5. Has the District ever implemented a nonstructural measure?	<u>6</u>	<u>27</u>
6. In feasibility studies, have any nonstructural plans been formulated specifically for implementation by local or Government agencies other than the Corps?	<u>12</u>	<u>21</u>
a. What were these plans?		
7. Has a combination of structural-nonstructural plans been economically feasible, recommended or implemented?	<u>20</u>	<u>13</u>
8. In view of recent Corps policy (Oct 79 memo from OCE) on flood warning, are flood warning systems being formulated in your studies?	<u>24</u>	<u>9</u>

9. Have there been other nontraditional nonstructural type measures under consideration or implemented (land acquisition, bridge modifications, groundwater recharge, greenbelts, natural flood storage, etc.)?

Yes

No

22

11

a. What were these measures?

10. In light of the revisions to Principles and Standards, where NED + EQ are coequal objectives and net NED + EQ benefits apply (plans need not be economically justified), do you expect an increase in recommended nonstructural measures?

17

16

11. What do you see as impediments to Corps implementation of nonstructural measures?

12. What changes, if any, are needed in Corps or Federal water resources policy on nonstructural measures?

(If additional space is needed to answer questions, continue on reverse side.)

Please return questionnaire to: Allen Chin  
BERH  
Kingman Building  
Fort Belvoir, VA 22060

Name of District person to contact regarding questionnaire: \_\_\_\_\_

\*Those (more traditional) nonstructural measures that the Corps can implement such as relocation, floodproofing and flood warning.

## FOOTNOTES

1. This is a very difficult task because of the sheer volume of planning studies and their dynamic nature, e.g. what may seem implementable today may be unacceptable after a final public meeting.
2. A more detailed discussion of the inherent problems of nonstructural measures will be covered in a subsequent chapter.
3. U. S. Army Corps of Engineers, Water Spectrum, WRSC, Fort Belvoir, Va., Fall 1980, p. 5.
4. Platt, Rutherford, Options to Improve Federal Nonstructural Response to Floods, Water Resources Council, Washington, D. C., December 1979, p. 16.
5. U. S. Water Resources Council, A Unified National Program for Flood Plain Management, Washington, D. C., September 1979, p. VI-15.
- 6-7. ER's 1105-2-353 and 1165-2-122 have been circulating as proposed rules since 1977/1978.
8. Best policy discussion ever written on Corps involvement in nonstructural measures.
9. U. S. Army Corps of Engineers, The Development of Nonstructural Alternatives: A Policy Discussion, St. Paul District, May 1979, Preface.
10. Recent studies have shown that nonstructural or floodplain management measures are more difficult to implement on fully developed floodplains than on vacant or sparsely developed floodplains.
11. Rutherford, Appendix F, p. 1.
12. Phone discussion with Prairie du Chien Relocation Office.
13. Corps of Engineers, Saginaw River, Michigan and Tributaries, Phase I GDM, Detroit District, July 1980.
14. Corps of Engineers, Basset Creek Watershed, St. Paul District, March 1976.
15. Corps of Engineers, Planners Bulletin, Board of Engineers for Rivers and Harbors, December 1980, p. 3; and phone discussion with Mobile District.
16. 96th Congress, 2d Session, U. S. Senate, S. 3170, September 30, 1980, p. 25.
17. Corps of Engineers, Detailed Project Report on Brewton and East Brewton, Alabama (Draft), Mobile District, p. 22; and discussion with Project Manager in Mobile District.
18. Phone conversation with Detroit District.

19. Discussion with Tulsa District.

20. Corps of Engineers, Waimea River, Kauai, Hawaii, DPR & EIS, Honolulu District, May 1980, pp. 25-26.

21. Corps of Engineers, Pawtuxet River Flood Control Report, New England Division, August 1980, and discussion with New England Division.

22. Discussion with Galveston District

23. 10 July 1978 memo from Michael Blumenfeld, Deputy Under Secretary of the Army to the Director of Civil Works.

24. White, Gilbert F., Nonstructural Floodplain Management Study: Overview, U. S Water Resources Council, Washington D.C., Oct. 1979, p3.

25. It should be noted that the questionnaires were filled out before the 6 January 1981 Policy Guidance on Nonstructural Flood Damage Reduction Measures.

26. Previous emphasis on high levels of protection for structural projects have resulted in confusion for floodproofing.

27. St. Paul District, p. 81.

28. Interagency task forces are being formed (one member from Corps) that will respond to disasters--see 10 July 1980 memo from James McIntyre, Director of OMB, to the Secretaries and Chairmen of various agencies.



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19. \_\_\_\_\_, Engineer Regulation 1105-2-353, Evaluation of Nonstructural Measures, Office of the Chief of Engineers, Washington, D. C., 4 April 1979.
20. \_\_\_\_\_, Engineer Regulation 1165-2-26, Implementation of Executive Order 11988, Floodplain Management, 15 May 1979.
21. \_\_\_\_\_, Engineer Regulation 1165-2-122, Use of Nonstructural Measures in Planning for Flood Damage Reduction, Office of the Chief of Engineers, Washington, D. C., Proposed Rule.
22. \_\_\_\_\_, Engineer Regulation 1165-2-303, Flood Plain Management Services Program, 1 April 1980.
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24. \_\_\_\_\_, Policy on Nonstructural Flood Damage Reduction Measures, DAEN-CWR-P, Office of the Chief of Engineers, Washington, D. C., 6 January 1981.
25. U. S. Water Resources Council, Principles and Standards for Planning Water and Related Land Resources, Washington, D. C., 14 December 1979.
26. \_\_\_\_\_, A Unified National Program for Flood Plain Management, Washington, D. C., September 1979.
27. U. S. Senate, S. 3170, 96th Congress, 2d Session, Washington, D. C., 30 September 1980.
28. White, Gilbert F., Nonstructural Floodplain Management Study: Overview, U. S. Water Resources Council, Washington, D. C., October 1979.